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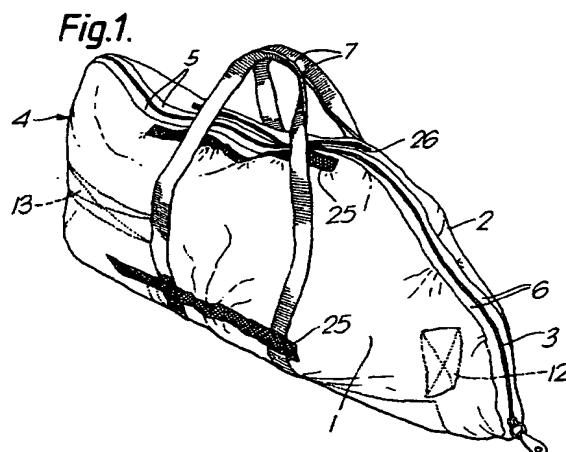
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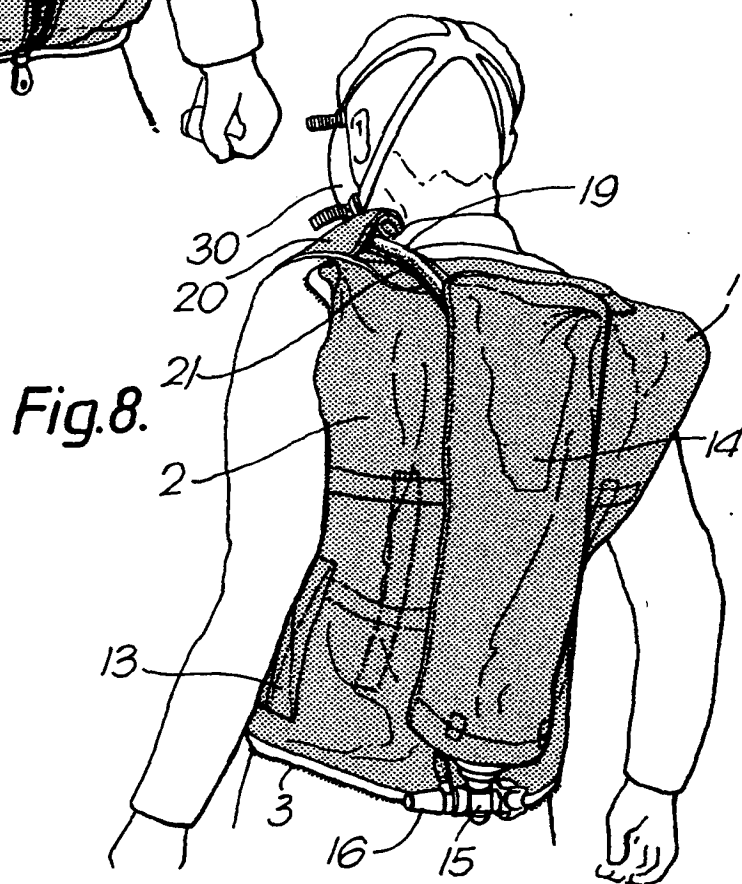
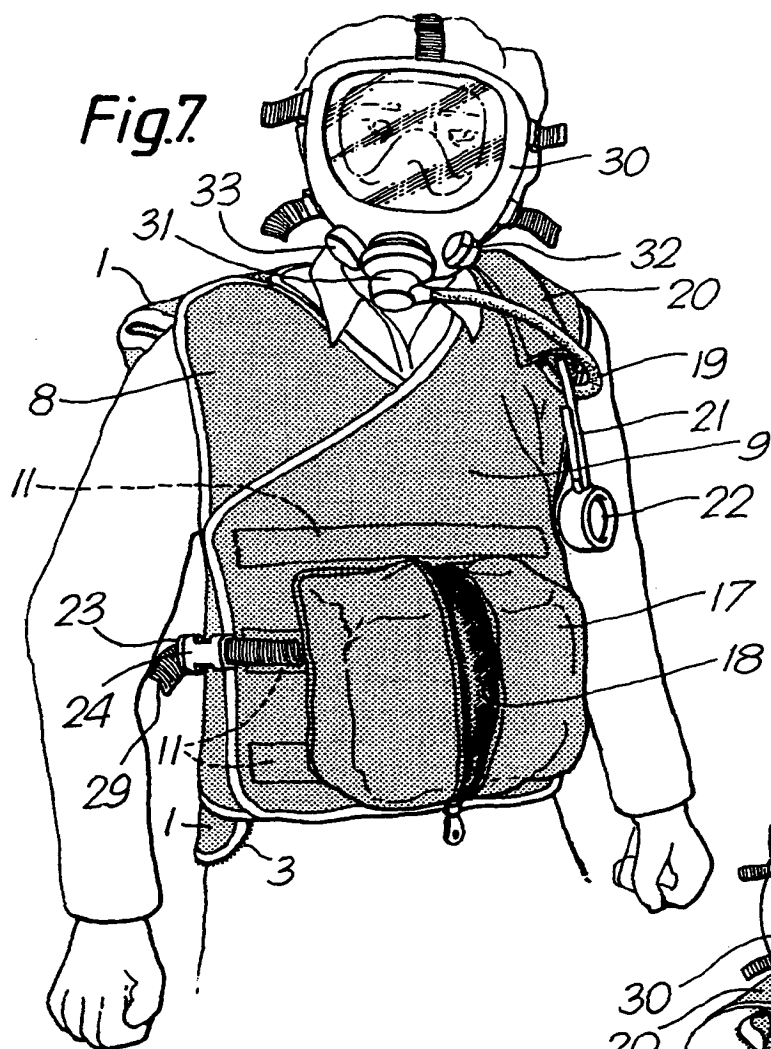
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⑤④ **Breathing apparatus.**

⑤⑦ A self contained breathing apparatus comprises a compressed air cylinder (in pouch 14), facemask (10) and hose (19) which when not in use are stored and carried within a case (Fig 1) formed from an assembly of flexible sheet material. The elements of the case are constructed such that when it is opened and reversed it is adapted to form a garment (Figs 7 and 8) to be worn over the torso and support the air cylinder for use.



**EP 0 506 256 A1**



The present invention relates to self-contained breathing apparatus such as may be worn to sustain the respiration of its user in noxious or oxygen-depleted environments. Such apparatus conventionally includes a portable source of breathing gas (e.g. a compressed air cylinder) and breathing interface means (e.g. a full or partial facemask) through which the breathing gas is in use supplied from said source to the respiratory passages of the user at a regulated rate.

In the case of self-contained open-circuit compressed air breathing apparatus it is usual for the air cylinder(s) to be carried on the back of the user, being mounted for this purpose on a plate or frame attached to a body harness comprised of strong webbing which passes over the user's shoulders and around his waist. As an alternative to this form of harness, it is known to support the cylinder on the back of a jerkin-type garment. Breathing sets are also known where an air cylinder is slung by a strap across one shoulder to be worn at the hip, but this arrangement is only suitable for relatively small and light cylinders, consequently providing very short endurance. A back-carrying harness arrangement is generally preferred because the weight of the cylinder(s) is distributed symmetrically and at a position which impedes the movements of the user the least.

In one aspect, the present invention seeks to provide a self-contained breathing apparatus with means for its storage and transportation when not in use and which, by suitable conversion when the apparatus is to be donned for use, avoids the need for a separate supportive harness. The invention has been developed in particular for use with open-circuit compressed air breathing apparatus of the kind generally known as "inspection" or "escape" sets using a cylinder of typically 3 to 6 litres capacity which will provide a nominal endurance of, say, 15 to 30 minutes. However, the invention is by no means limited to such usage and in principle may be used in conjunction with any size or form of portable breathing gas source which is capable of being supported on the torso. In particular, in addition to open-circuit compressed air (or oxygen) breathing apparatus the invention may find application to the closed-circuit regenerative type of self-contained oxygen breathing apparatus.

Accordingly in one aspect the invention resides in self-contained breathing apparatus comprising a portable source of breathing gas and breathing interface means through which the breathing gas is in use supplied from said source to the respiratory passages of the user at a regulated rate, together with an assembly of flexible sheet material which can be folded and closed to form a case enclosing at least said gas source when not in use and which when opened and reversed is adapted to form a garment to be worn over the torso and to support the gas source for use, preferably on the back of the user.

In a preferred embodiment the case encloses a complete breathing circuit ready for use subject to opening the case, donning the garment and breathing interface means, and opening a valve to release breathing gas from the source thereof to the interface means. The garment which the flexible sheet material is adapted to form preferably is in the nature of a jerkin (vest) which is donned by passing the arms through respective holes and closing together two sides across the chest.

A preferred embodiment of the invention will now be more particularly described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of the case within which the remainder of the apparatus can be carried;

Figure 2 is a plan view of the apparatus with the case opened and its side flaps unfolded;

Figure 3 is a plan view of the apparatus following from the condition of Figure 2, with two inner flaps unfolded;

Figure 4 is a plan view of the apparatus turned over from the condition of Figure 3;

Figure 5 is a plan view of the apparatus following from the condition of Figure 4, with the originally outer flaps folded inwards, and the garment now ready for donning;

Figure 6 is a perspective view showing the garment during donning; and

Figures 7 and 8 are respective perspective views from the front and rear showing the breathing apparatus in use.

The following particular description indicates the sequence of operations which is performed to convert the illustrated breathing apparatus, which is of the open-circuit compressed air kind, from its stored mode into its operational mode. For ease of illustration, the flexible sheet material from which the illustrated case/jerkin is made is shown shaded on one side and unshaded on the other.

Referring to Figure 1, the illustrated case is formed from a single piece of synthetic fabric, such as the multilayer, flame resistant, plasticised PVC on polyester fabric known as CAFLEX FP600FR, (CAFLEX is a trade mark of Coating Applications (Textiles) Limited). In principle, however, any natural or synthetic fabric that will support the weight of the breathing apparatus and meet other relevant performance criteria may be used. This case has two folded-up side flaps 1 and 2 which are held together along the length of their upper (as viewed) edges by a zip fastener 3. More particularly, and as also indicated in Figure 2 which shows the flaps 1 and 2 unfolded, the flap edges which are united in the Figure 1 condition have respective generally straight lengths 4 at the rear (as viewed) of the case leading to second generally orthogonal straight lengths 5 at the top of the case and in-

clined lengths 6 at the front (as viewed) of the case. Loops of webbing 7 are sewn on to provide handles for hand-carrying the case. Alternatively, longer loops may be provided if it is preferred to carry the case over the shoulder.

Figure 2 shows the apparatus after releasing the zip fastener 3 and unfolding the side flaps 1 and 2, their inner surfaces now being seen. It is assumed that the apparatus is laid out on a floor, table or other flat surface. Revealed inside the case are two inner flaps 8 and 9, folded one over the other and held together by respective perpendicular strips 10, 11 of the synthetic fibre fastening material known as VELCRO, (VELCRO is a registered trade mark of Selectus Limited). The inner flaps 8 and 9 are made from respective pieces of the same material as forms the outer flaps 1 and 2 and are respectively attached to the outer piece at their top and lower-side edges, at the regions indicated by the stitched patches 12 and 13 in Figures 3 and 4. The regions between the patches 12 and 13 where the flaps 8 and 9 are not attached to the outer piece will form the arm holes 27 and 28 of Figure 5 when the garment is ready for donning. Also seen in Figure 2 is the top of the cylinder pouch 14 which is revealed in its entirety in Figure 3.

Figure 3 shows the apparatus after separating and folding back the inner flaps 8 and 9. A pouch 14 is sewn centrally to the outer piece of fabric, at a position which lies along the base of the case in Figure 1. This pouch is open at its lower (as viewed) end to receive a compressed air cylinder which is hidden from view in Figure 3 apart from its on/off valve fitting 15 and attached first-stage pressure reducer 16. Another pouch 17, closed by a central zip fastener 18, is sewn onto the now-revealed side of the inner flap 9, which houses a facemask fitted with a demand valve; (these items will be seen at 30 and 31 in Figure 7). A low-pressure hose 19 leads up through the cylinder pouch 14 from the low-pressure side of the pressure reducer 16 and down through a fabric guide 20 to the facemask demand valve in pouch 17. A high-pressure hose 21 leads in parallel to the hose 19, but from the high-pressure side of the fitting 16, to a conventional cylinder contents (pressure) gauge and low-pressure warning whistle assembly 22. Also seen in Figure 3 are the two parts of a waist clip fastener 23, 24 which will be attached together when the apparatus is donned.

Figure 4 shows the apparatus after turning it over bodily from its Figure 3 condition. From this condition the two side flaps 1 and 2 of the case are folded in on themselves as shown in Figure 5, with the respective carrying handles 7 trapped between them. These flaps are held in the folded-in condition by respective pairs of VELCRO strips 25, 26 seen in Figure 4. With the flaps 1 and 2 folded in and their top edges tucked out through the arm holes 27, 28 as shown in Figure 5, the apparatus is ready for donning. The three fabric

pieces 1/2, 8 and 9 collectively define a jerkin or vest, of which the back is provided by the folded piece 1/2, (which originally defined the case of Figure 1), and the two sides are provided by respective "inner" flaps 8 and 9 (which are now, of course, on the outside). As previously indicated, the arm holes 27, 28 seen in Figure 5 are defined between the patches 12 and 13 where the respective flaps 8 and 9 are stitched to the flaps 1 and 2.

The jerkin is donned by the user passing his right and left arms respectively through the arm holes 27 and 28 so that the folded-in flaps 1, 2 lie along his back on the inside of the garment, with the cylinder pouch 14 of course now being located on the outside. Flap 8 is folded across his chest from the right (as worn) and flap 9 is folded across the top of the flap 8 from the left. For ease of illustration Figure 6 shows the jerkin donned and flap 9 partially folded over. The flaps 8 and 9 are held together across the chest by interengaging VELCRO strips 10 and 11, their perpendicular orientation permitting engagement over a wide range of different chest sizes. The fastening is completed by clipping together the two parts of the fastener 23, 24 as shown in Figure 7 adjusting if required by pulling through the length of webbing 29 by which the fastener part 23 is attached to the flap 1 (see also Figure 3). The principal fastening of the flaps 8 and 9 around the body of the user is achieved by the VELCRO strips 10 and 11, however, the fastener 23, 24 serving only as a safety device to prevent the accidental tearing open of the VELCRO connection.

With the jerkin thus donned, the facemask pouch 17 is now located on the chest of the user. The zip fastener 18 is released to permit removal and donning of the facemask 30 as shown in Figure 7. It is shown in this Figure fitted with a positive-pressure demand valve 31 connected to the hose 19, an exhalation valve 32 and speech transmission diaphragm 33. The breathing circuit remains connected up while the apparatus is in its storage mode so all that is required to put it into operation is for the user to don the facemask and turn on the air supply from the cylinder by turning the handwheel of the valve 15 seen in figure 8. The air cylinder may be supported within the pouch 14 by any convenient means, such as by a ring around the neck of the (inverted) cylinder attached by dog clips to rings sewn into the open (lower) end of the pouch.

After use and any replacement or recharging of the air cylinder, the apparatus is returned to its storage mode within the bag of figure 1 by reversal of the procedure described above.

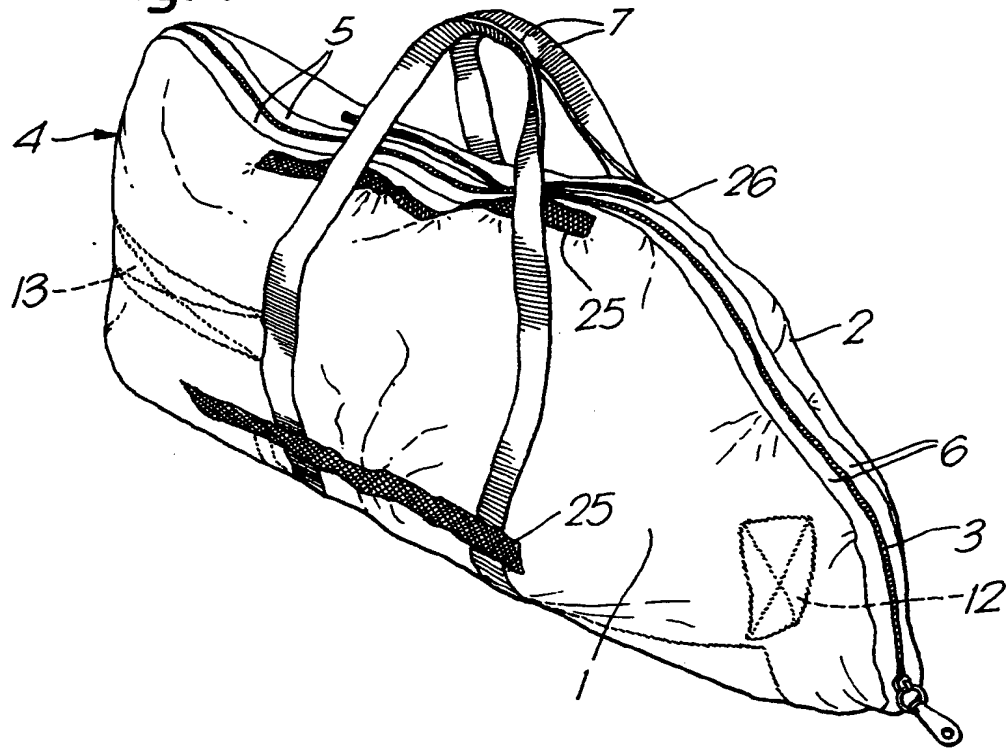
The guide 20 seen most clearly in figure 6-8 is formed from a loop of fabric and made large enough for the pressure reducer 16 and hoses 19, 21 (or gauge/whistle 22 and hoses) to pass through it. The loop is then folded on itself and held together by VELCRO strips so that when in use the hoses are held firmly in position.

A particular advantage of the illustrated apparatus is that the whole breathing circuit is held in place by the design of the garment and no tools are required to remove it from the garment when cleaning or disinfection/decontamination is to be carried out.

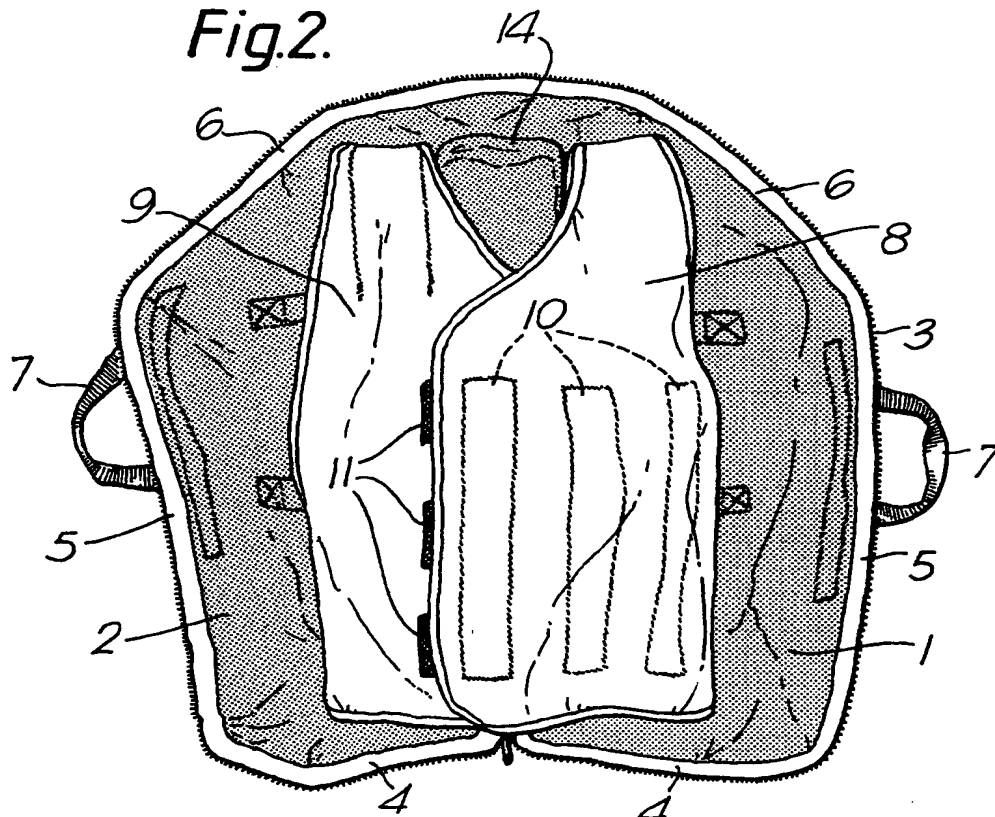
## Claims

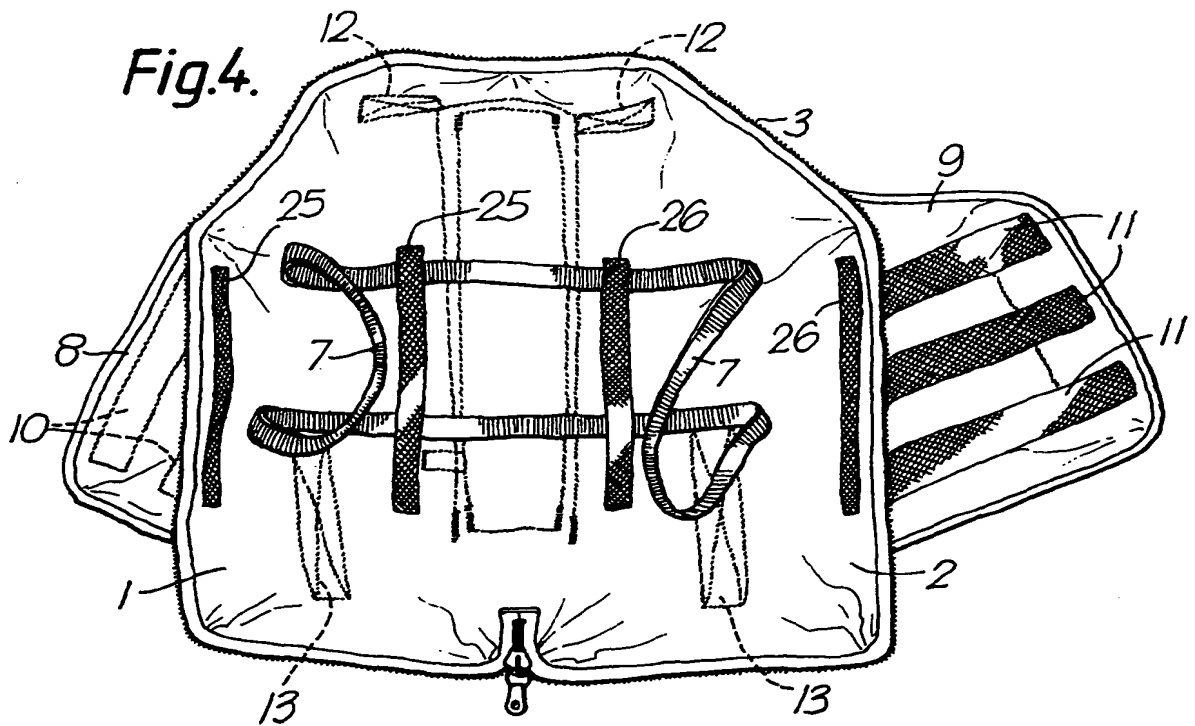
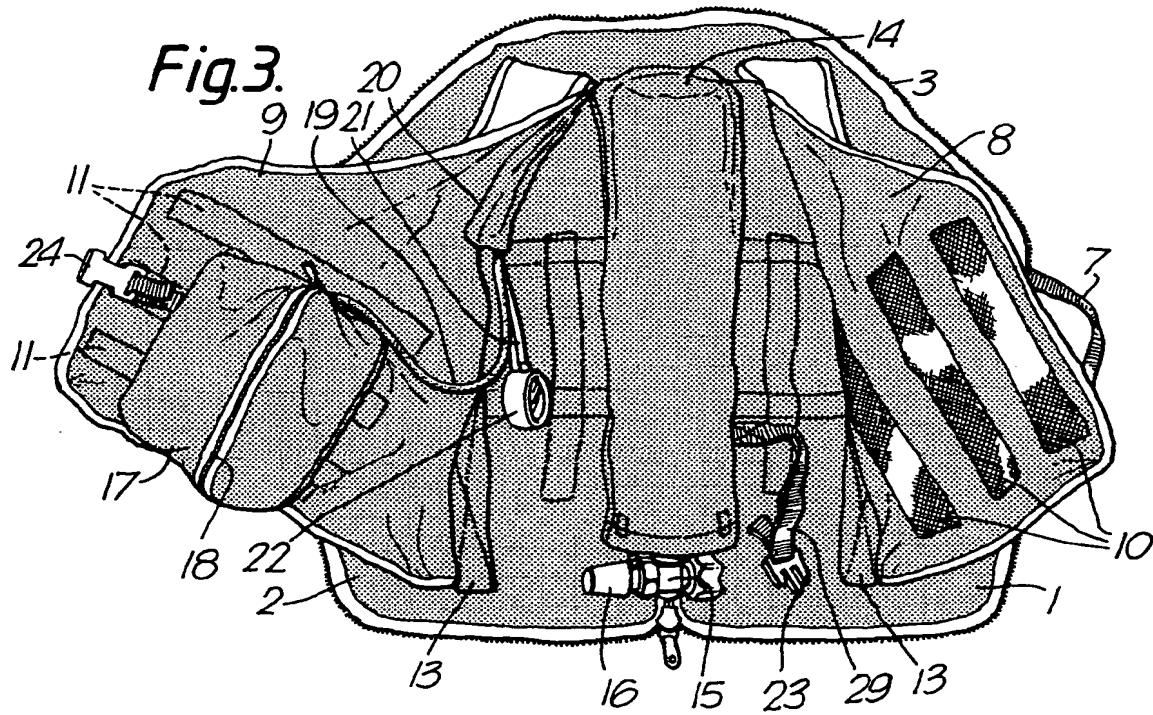
1. Self-contained breathing apparatus comprising a portable source of breathing gas (14,15,16) and breathing interface means (30,31) through which the breathing gas is in use supplied from said source to the respiratory passages of the user at a regulated rate, together with an assembly of flexible sheet material (1,2,8,9) to form a garment to be worn over the torso and to support the gas source for use characterised in that said assembly of flexible sheet material can be folded and closed to form a case (Fig 1) enclosing at least said gas source when not in use and which when opened and reversed (Figs 2-4) is adapted to form said garment (Figs 5-8).
2. Apparatus according to claim 1 wherein said garment (Figs 5-8) is adapted to support the gas source (14,15,16) on the back of the user.
3. Apparatus according to claim 1 or 2 wherein said case (Fig 1) also encloses said breathing interface means (30,31).
4. Apparatus according to claim 3 wherein said case (Fig 1) encloses a complete breathing circuit (14,15,16,19,31,30,32) ready for use subject to opening the case, donning the garment (Figs 5-8) and breathing interface means (30,31), and opening a valve (15) to release breathing gas from the source thereof to the interface means.
5. Apparatus according to any preceding claim wherein said garment (Figs 5-8) is in the nature of a jerkin which can be donned by passing the arms through respective holes (27, 28) and closing together two sides (8,9) of the garment across the chest.
6. Apparatus according to any preceding claim wherein said assembly of flexible sheet material comprises a first element (1,2) which defines the confines of said case (Fig 1) when folded and closed together around mating edges (4,5,6) thereof, and two further elements (8,9) attached to said first element to lie interiorly of said case; said further elements, when the case is opened to form said garment (Figs 5-8), defining flaps (8,9) to fold around the front of the torso while said first element (1,2) lies at the rear of the torso.
7. Apparatus according to claims 5 and 6, wherein said holes (27,28) are defined between respective regions of attachment (12,13) of said further elements (8,9) to said first element (1,2).
8. Apparatus according to claim 6 or claim 7 wherein a compartment (17) for the storage of said breathing interface means (30,31) when not in use is provided on one surface of one of said further elements (9), whereby said compartment lies between that one element and said first element (1,2) within said case (Fig 1) but, when the case is opened to form said garment and donned, said compartment lies to the exterior thereof in the region of the chest of the user (Figs 6,7).
9. Apparatus according to any preceding claim wherein a tubular pouch (14) to receive said gas source is provided on said assembly to lie along the base of said case (Fig 1) but, when the case is opened to form said garment and donned, said pouch lies to the exterior thereof along the back of the user (Fig 8).
10. An assembly of flexible sheet material (1,2,8,9) adapted to form the case (Fig 1) and garment (Figs 5-8) for the breathing apparatus of any preceding claim.

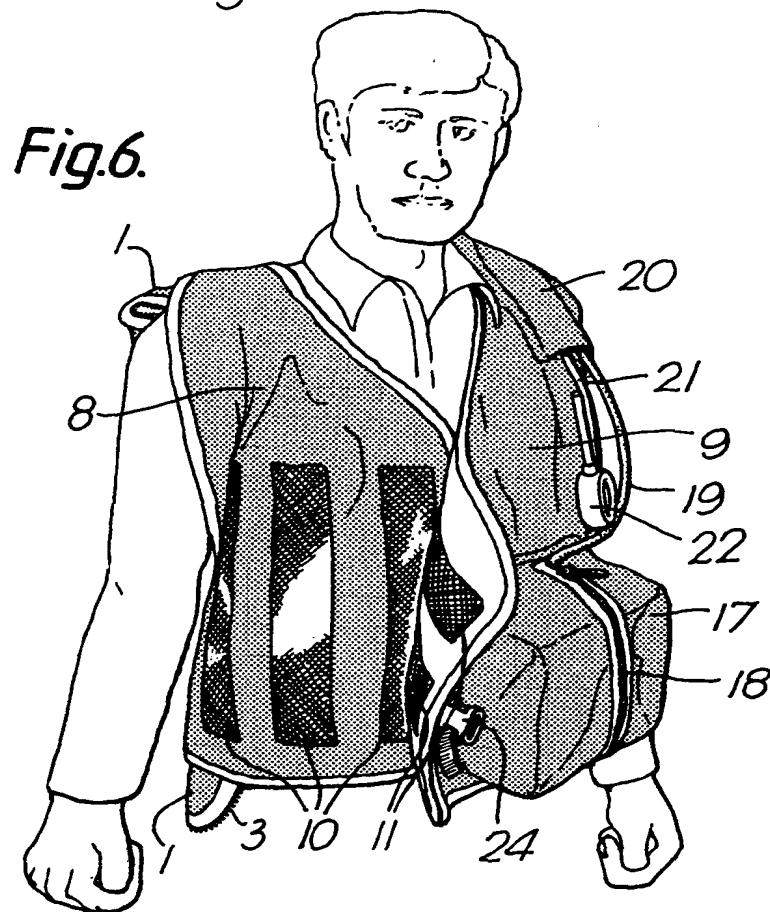
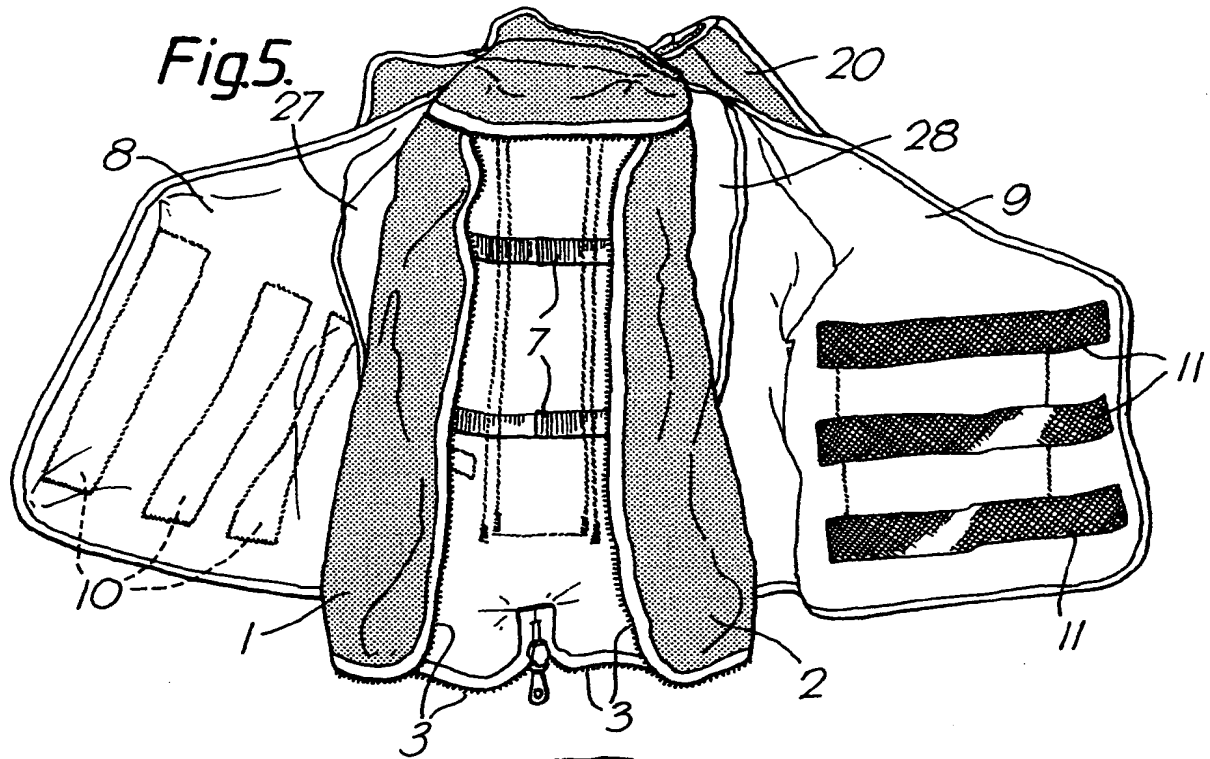
*Fig.1.*



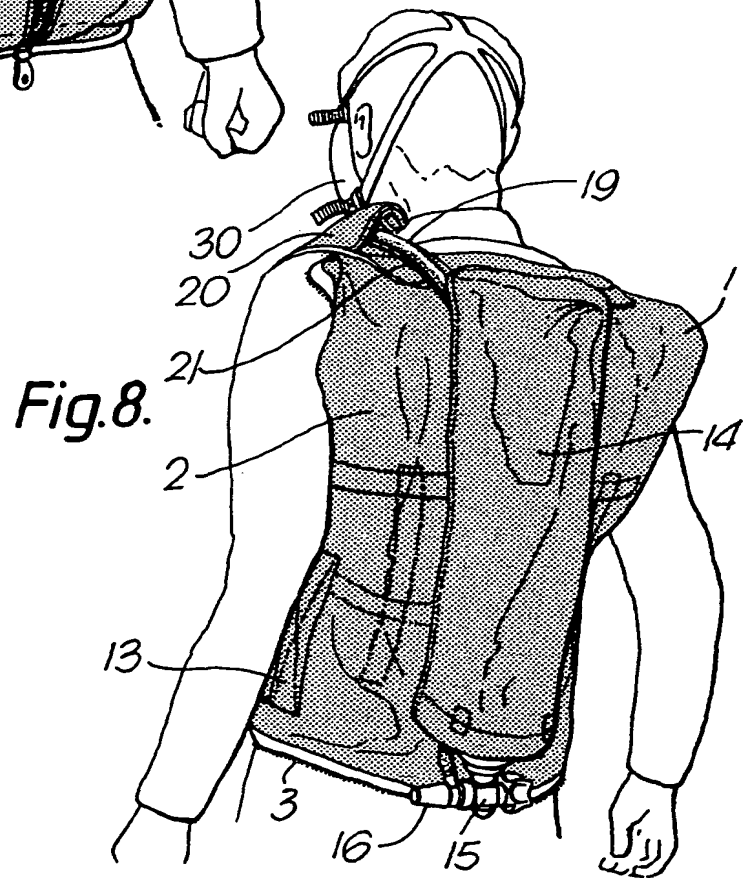
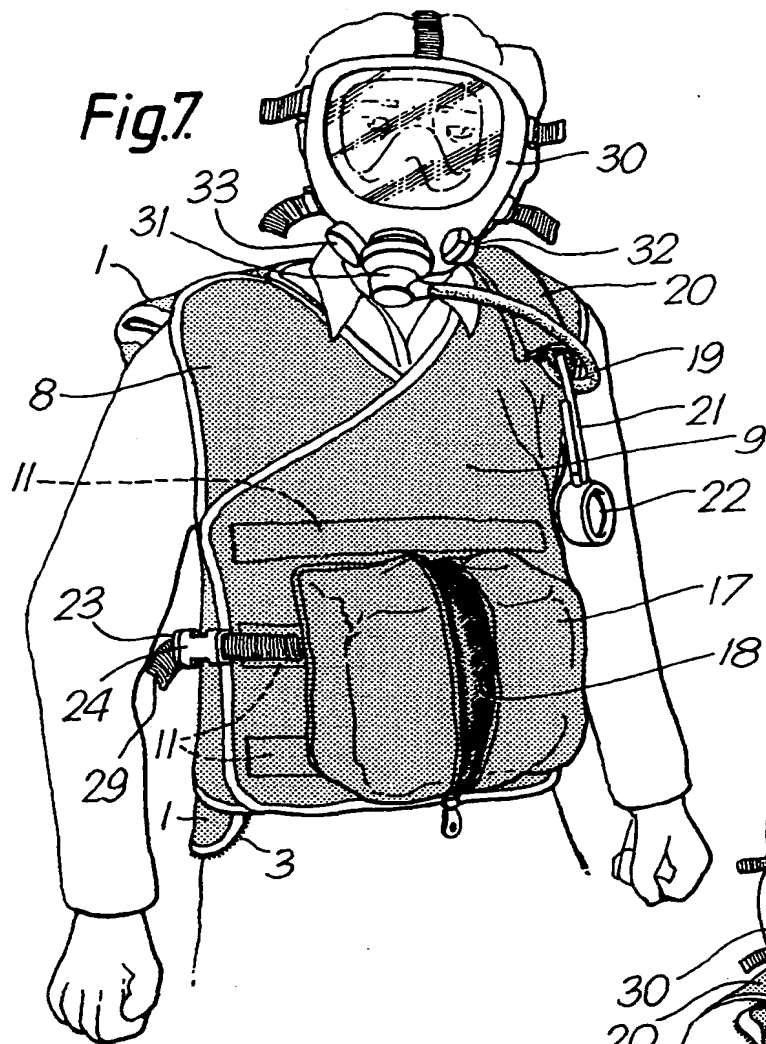
*Fig.2.*













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# EUROPEAN SEARCH REPORT

Application Number

EP 92 30 2100

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	GB-A-2 056 260 (ARISLAND) * figures *	1, 10	A62B25/00
A	DE-B-1 210 327 (VEB MEDIZINTECHNIK LEIPZIG) * claims; figures *	1, 10	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			A62B A410 A45F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24 JUNE 1992	Examiner ERNST R. T.
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